(12) UK Patent Application (19) GB (11) 2 295 588 (13) A

(43) Date of A Publication 05.06.1996

(21) Application No 9424212.0

(22) Date of Filing 30.11.1994

(51) INT CL[6]
B60G 3/24

(52) UK CL (Edition O)
B7D DSCV

(56) Documents Cited
None

(58) Field of Search
UK CL (Edition N) B7D DSCV
INT CL[6] B60G 3/08 3/24
Online databases: WPI, EDOC, JAPIO

(71) Applicant(s)
GKN Automotive AG

(Incorporated in the Federal Republic of Germany)

Hauptstrasse 150, 53797 Lohmar,
Federal Republic of Germany

(72) Inventor(s)
Frederick William Boulton

(74) Agent and/or Address for Service
Forrester Ketley & Co
Chamberlain House, Paradise Place, BIRMINGHAM,
B3 3HP, United Kingdom

(54) Vehicle suspension and drive arrangement

(57) A suspension and drive arrangement for a motor vehicle comprises a differential unit 10 having a casing 11 and two outputs connected to universally-jointed driveshafts 17 extending laterally to hub carrier units 24, and respective generally tubular members 20 surrounding the driveshafts and pivotally connected to the hub carrier units 24; at least one of the generally tubular members being pivotally connected to the casing of the differential unit and such pivotal connection and/or the connection of the differential unit to the vehicle structure providing for pivotal movement of the two generally tubular members relative to one another about at least one axis adjacent the differential unit; the two nub carrier units thus being movable upwards and downwards relative to the vehicle structure and being guided for such movement by, for example, telescopic struts.

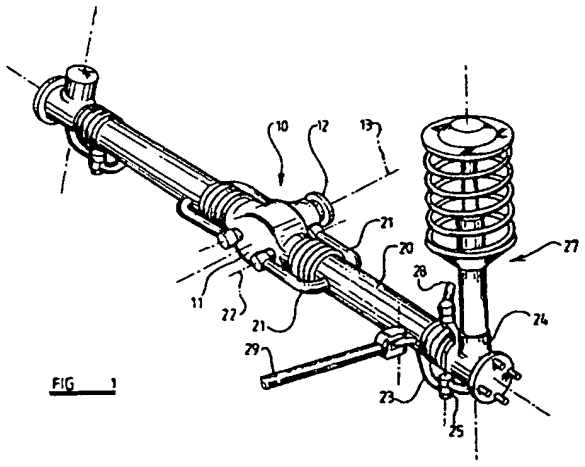

FIG 1

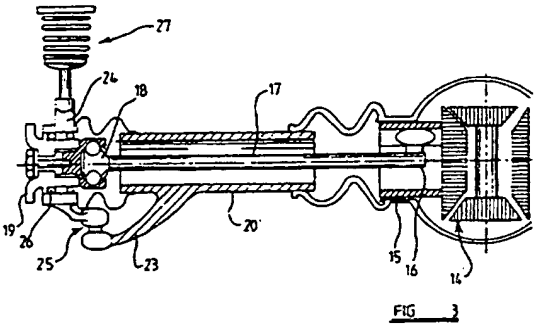

FIG 3

GB 2 295 588 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The print reflects an assignment of the application under the provisions of Section 30 of the Patents Act 1977.

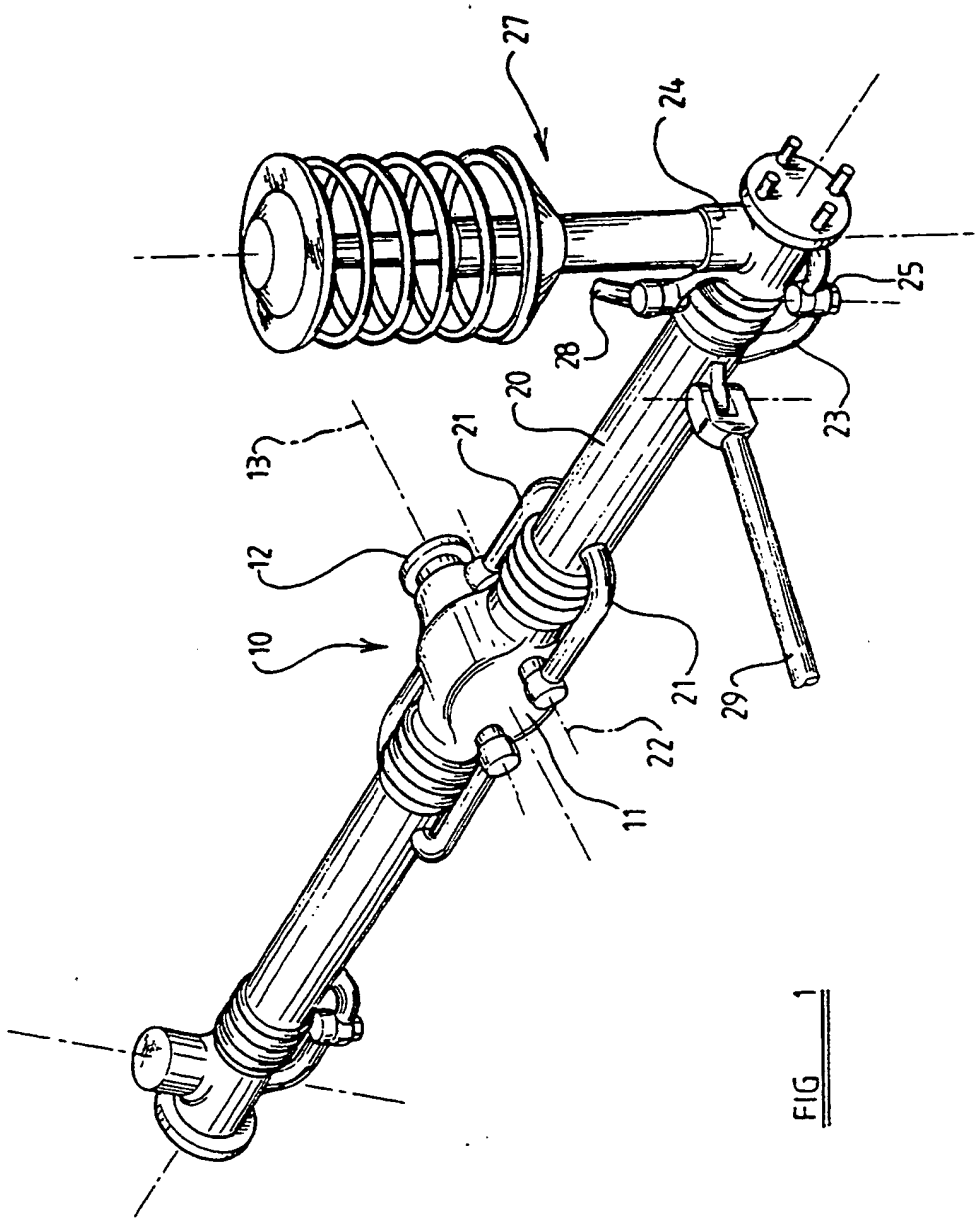

FIG 1

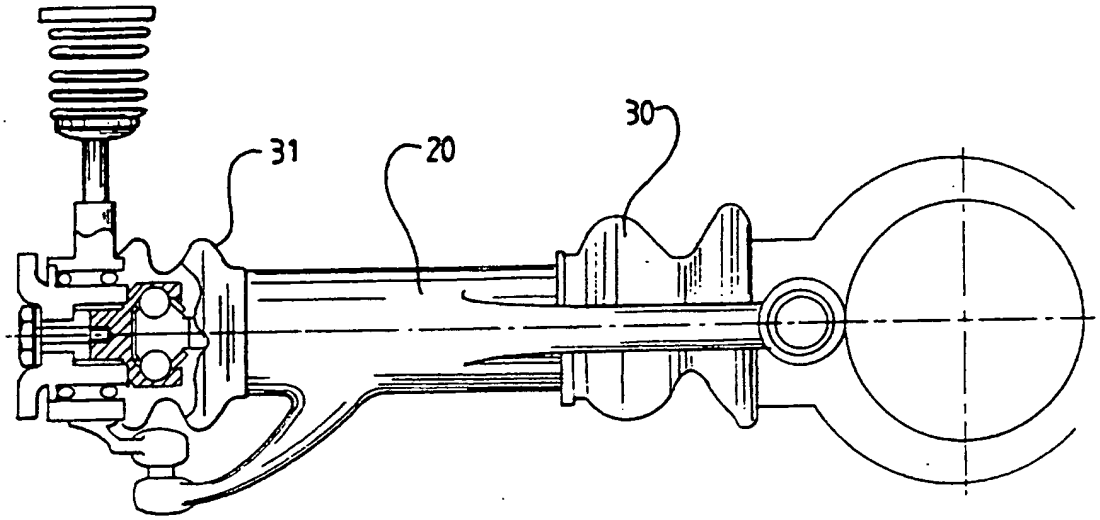

FIG 2

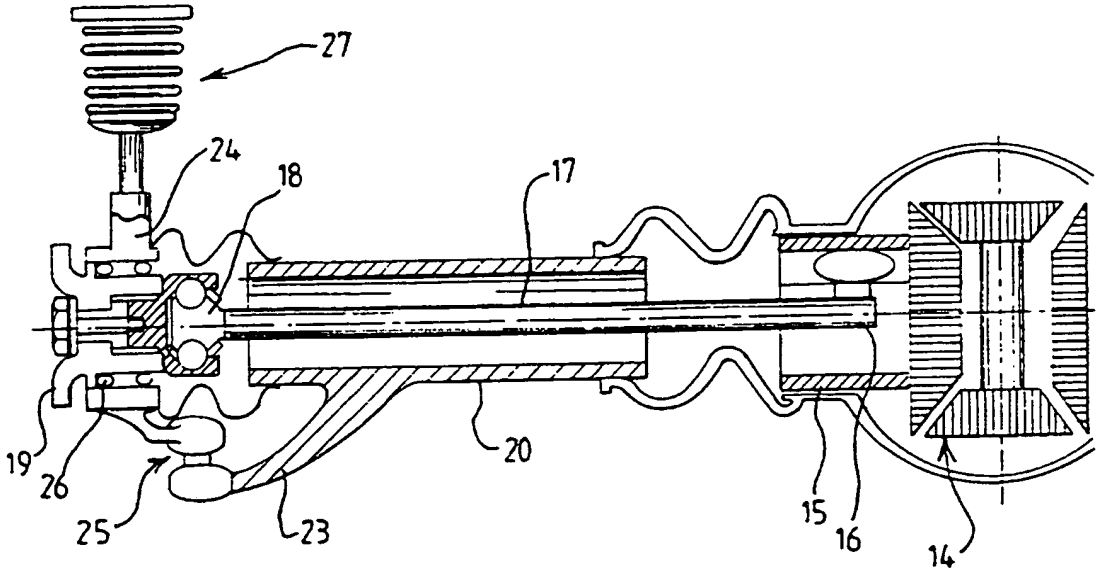

FIG 3

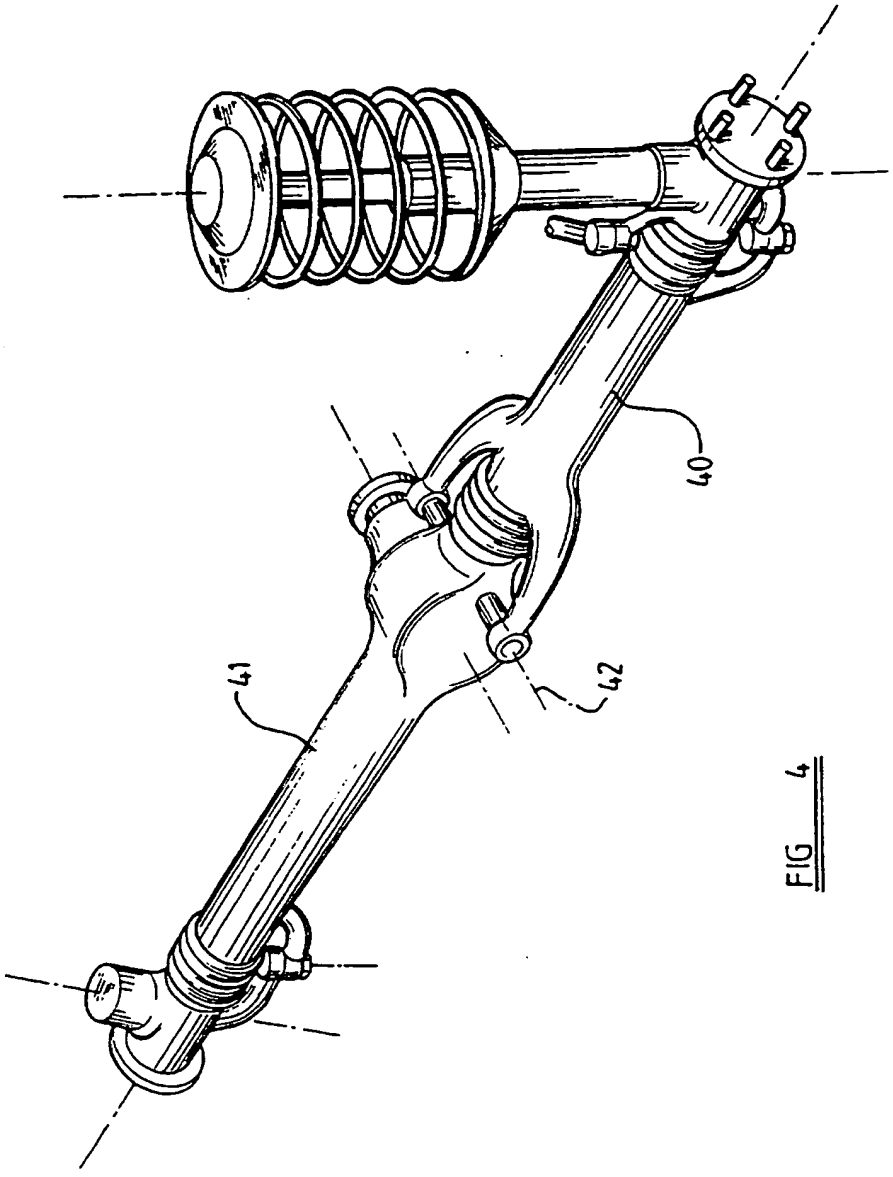

FIG 4

Title: "Vehicle Suspension/Drive Arrangement"

Description of Invention

This invention relates to a suspension/drive arrangement for a motor vehicle.

The invention has been devised primarily for use in light commercial vehicles and on/off road 4x4 passenger vehicles or cars. Such vehicles have hitherto conventionally been provided with rigid beam axles, but increasingly independent suspension systems are being used on such vehicles. When independent suspension systems are used, the high ground clearance and large wheel travel relative to the body/chassis structure of the vehicle results in packaging compromises which disadvantageously affect the suspension geometry.

Specifically, most 4x4 leisure/agricultural vehicles use an in-line engine layout, which necessitates the disposition of the differential for the front wheels to one side of the sump of the engine if a very high bonnet line is to be avoided, whether a beam axle or independent front suspension is used. When an independent front suspension is used, the offset differential results in a relatively short lower suspension wishbone, with the result of a poor compromise between the various aspects of the suspension geometry such as track change and change in camber with wheel movement.

It is broadly the object of the present invention to overcome or reduce such disadvantages, to enable vehicle designers to improve packaging.

According to one aspect of the invention, we provide a vehicle suspension/drive arrangement comprising a differential unit supported by the vehicle body/chassis structure, and comprising an input and outputs connected to respective universally-jointed drive shafts extending laterally to road wheels of the vehicle; respective generally tubular members substantially enclosing the drive shafts, said generally tubular members having their respective innermost ends

connected to the differential unit and their outermost ends pivotally connected to hub carrier units, the support of the differential unit and/or connection of the two generally tubular members to the differential unit providing for the pivotal movement of the two generally tubular members relative to one another about at least one axis at or adjacent the differential unit, and thereby for upwards and downwards movement of the two hub carrier units relative to the vehicle structure; and respective guide means connected to each hub carrier unit, the guide means and generally tubular members together constraining the hub carrier unit to a required path of upwards and downwards movement relative to the vehicle structure.

The guide means for each hub carrier unit may comprise a strut which may be a conventional telescopic strut incorporating a damper and having a spring associated therewith. Such a strut together with the pivotal connection of the hub carrier unit to the generally tubular member may also provide for steering movement of the hub carrier unit.

Alternatively, a guide means for each hub carrier unit may comprise a pivoted arm or other member or structure,, e.g. of the type commonly referred to in the context of automotive suspensions as a "wishbone". Other members assisting in the guidance and/or control of movement of the hub carrier units may be provided, e.g. anti-roll bars, tie-bars, or other members or arrangements of members such as conventionally may be found in vehicle suspension systems.

Each of the generally tubular members may be pivotally connected to a casing part of the differential unit, so that there are two axes about which the tubular members are able respectively to pivot relative to the casing part of the differential unit.

Alternatively, one of the generally tubular members may be pivotally connected to a casing part of the differential unit whilst the casing of the differential unit is itself pivotally mounted to the vehicle structure and the other generally tubular member is rigidly connected thereto or even integral therewith as in a beam axle.

In an arrangement according to the invention, by disposing the generally tubular members around the drive shaft and, in a first embodiment, pivotally connecting them to the differential casing, the length of such members (which correspond to the lower wishbones of a conventional suspension) is maximised, thereby enabling a better geometrical compromise to be obtained. In the case of the embodiment where the differential unit itself may be pivotally mounted and a tubular member be integrally connected thereto, this advantage is further increased if the tubular member rigidly connected to the differential unit is the shorter one of the two tubular members.

Each generally tubular member and hub carrier unit may be connected together by a sealing means, preferably a flexible sealing boot, which permits the relative movement therebetween and defines an enclosure in which lubricant can be retained. The innermost end of the or each tubular member which is pivotally connected to the casing part of the differential unit is preferably also joined thereto by a sealing means such as a flexible sealing boot, so that a common oil supply may provide for lubrication of the drive shaft and universal joints thereof, the wheel bearing means provided at the hub carrier unit and also the differential unit.

The invention will now be described by way of example with reference to the accompanying drawings of which:

FIGURE 1 is a perspective view of a suspension in accordance with the invention;

FIGURE 2 is a partly sectional view of part of the suspension of Figure 1;

FIGURE 3 is a view as Figure 2 but further sectioned; and

FIGURE 4 is a perspective view of a further embodiment of the suspension in accordance with the invention.

Referring firstly to Figures 1 to 3 of the drawings, a differential unit is indicated generally 10, the differential unit having a casing 11 and an input constituted by a drive flange 12 rotatable about an axis 13. Within the casing 11

of the differential unit there is disposed a differential gearing as indicated at 14 in Figure 3, the differential gearing having two outputs facing laterally towards respective road wheels of the vehicle. The two outputs, one of which is shown in Figure 3, are connected to parts of constant velocity ratio universal joints and as shown for one of such of Figure 3 these outputs may be the outer members as indicated at 15 of tripode type constant velocity ratio universal joints. It will be appreciated, however, that joints of other appropriate type may be utilised. The inner member of each such joint, as indicated at 16 in Figure 3, is connected to a drive shaft thereon extending laterally outwardly from the differential unit and at whose outermost end is connected by way of a further constant velocity ratio universal joint 18 of any appropriate type, to a hub member 19.

Surrounding each drive shaft 17 is a respective tubular member h 20. At its innermost end, the tubular member 20 is provided with formations 21 which are pivotally connected to the differential casing 11, to permit the tubular member 20 to pivot about an axis 22. The axis 22 lies in a substantially horizontal orientation and as indicated is generally parallel to the axis 13. At its outermost end, the tubular member 20 has a formation 23 extending therefrom which is connected to a hub carrier unit 24 for universal pivotal movement, by way of a ball joint 25. The hub carrier unit 24 incorporates bearing means, as illustrated in Figures 2 and 3 a double row ball bearing assembly indicated at 26, by which the hub member 19 is rotatably supported.

The hub carrier unit 24 is further constrained relative to the vehicle structure by a strut indicated generally at 27 which incorporates a telescopic damper unit and has associated therewith a spring. As well as constraining the path of movement of the hub carrier unit and providing spring and damping, the strut 27 also permits steering movement of the hub carrier unit and in Figure 1 a steering arm 28 is illustrated connected to the hub carrier unit.

Also shown in Figure 1 is a tie rod 29 connected to the tubular member 20. Thus the tubular member together with the strut 27 and tie rod 29

provide a system which completely determines the path of possible movement of the hub carrier unit 24 relative to the vehicle structure.

The tubular member 20 is connected to the differential casing 11 by a flexible sealing boot 30, and to the hub carrier unit by a flexible sealing boot 31. Thus an enclosure is defined which may contain a common supply of lubricant for the differential gearing 14 incorporated within the differential unit 10, and also for the two constant velocity ratio universal joints at opposite ends of the drive shaft 17 and the bearing means 26 for the hub.

In the embodiment of Figures 1 to 3, the tubular member at each side of the differential unit is pivotally connected to the differential unit. The differential unit may thus be rigidly mounted to the vehicle structure although it will be appreciated that in practice flexible mountings will be utilised in order to provide for noise and vibration and isolation from the vehicle structure. An alternative to this arrangement is shown in Figure 4, in which at one side of the differential unit there is a tubular member 40 pivotally connected to the differential unit and substantially as above described in relation to Figures 1 to 3, whilst at the other side of the differential unit the tubular member, as indicated at 41, is rigidly connected or integral with the differential casing. The differential casing and member 41 therewith are pivotally mounted to the vehicle structure by a mounting which provides for pivotal movement thereof about the same axis 42 as that by which the member 40 is pivoted to the differential casing. At its outermost end, the tubular member 41 is connected to a hub carrier unit and strut, in the manner above described.

Although struts are above described for constraining the path of movement of the hub carrier units, it will be appreciated that other arrangements may be utilised for this purpose. For example, upper wishbones or pivoted arms could be employed. The provision of a common oil supply for the differential gearing, universal joints and bearings is not essential, but may be desirable in some designs.

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

CLAIMS:

1. A vehicle suspension/drive arrangement comprising a differential unit supported by the vehicle body/chassis structure, and comprising an input and outputs connected to respective universally-jointed drive shafts extending laterally to road wheels of the vehicle; respective generally tubular members substantially enclosing the drive shafts, said generally tubular members having their respective innermost ends connected to the differential unit and their outermost ends pivotally connected to hub carrier units, the support of the differential unit and/or connection of the two generally tubular members to the differential unit providing for the pivotal movement of the two generally tubular members relative to one another about at least one axis at or adjacent the differential unit, and thereby for upwards and downwards movement of the two hub carrier units relative to the vehicle structure; and respective guide means connected to each hub carrier unit, the guide means and generally tubular members together constraining the hub carrier unit to a required path of upwards and downwards movement relative to the vehicle structure.

2. An arrangement according to claim 1 wherein each of the generally tubular members is pivotally connected to a casing part of the differential unit, to provide for said pivotal movement of the two generally tubular members relative to one another about two axes.

3. An arrangement according to claim 1 wherein one of the generally tubular members is pivotally connected to a casing part of the differential unit whilst the other generally tubular member is rigidly connected to said casing part, said casing part itself being pivotally mounted to the vehicle structure.

4. An arrangement according to any one of the preceding claims wherein each generally tubular member and hub carrier unit are connected by a sealing means defining a common enclosure in which lubricant can be contained.

5. An arrangement according to claim 2, or claim 3, or claim 4 as appendant to claim 2 or claim 3, wherein at each pivotal connection of the innermost end of a tubular member to the casing part of the differential unit there is a sealing means to define a common enclosure in which lubricant can be retained.

6. An arrangement according to claim 4 or claim 5 wherein each said sealing means is a flexible sealing boot.

7. An arrangement according to any one of the preceding claims wherein the guide means for each hub carrier unit comprises a telescopic strut, a pivoted member or structure, or the like.

8. Any novel feature or novel combination of features described herein and/or in the accompanying drawings.

Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report)	Application number GB 9424212.0
Relevant Technical Fields (i) UK Cl (Ed.N) B7D (DSCV) (ii) Int Cl (Ed.6) B60G 3/08, 3/24	Search Examiner COLIN THOMPSON Date of completion of Search 30 JANUARY 1995
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE DATABASES: WPI, EDOC, JAPIO	Documents considered relevant following a search in respect of Claims :- 1 TO 7

Categories of documents

X:	Document indicating lack of novelty or of inventive step.	P:	Document published on or after the declared priority date but before the filing date of the present application.
Y:	Document indicating lack of inventive step if combined with one or more other documents of the same category.	E:	Patent document published on or after, but with priority date earlier than, the filing date of the present application.
A:	Document indicating technological background and/or state of the art.	&:	Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
	NONE	

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).